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(54) Abstract Title
Head-induced syphonic rainwater outlet

(57) The outlet 10 for draining surfaces or gutters is capable of inducing syphonic flow at high water flow rates, with a gradual transition to syphonic flow as the depth of water in sump 14 increases. The outlet 10 comprises a sump 14 for reception of water to be drained, an inlet orifice 57 leading to a discharge passage d fined between the underside of a cap 46 and a crest 54 formed in the sump floor surrounding a spigot 16. The uppermost point 56 of the inlet orifice 57 lies substantially at or above the level of the crest.

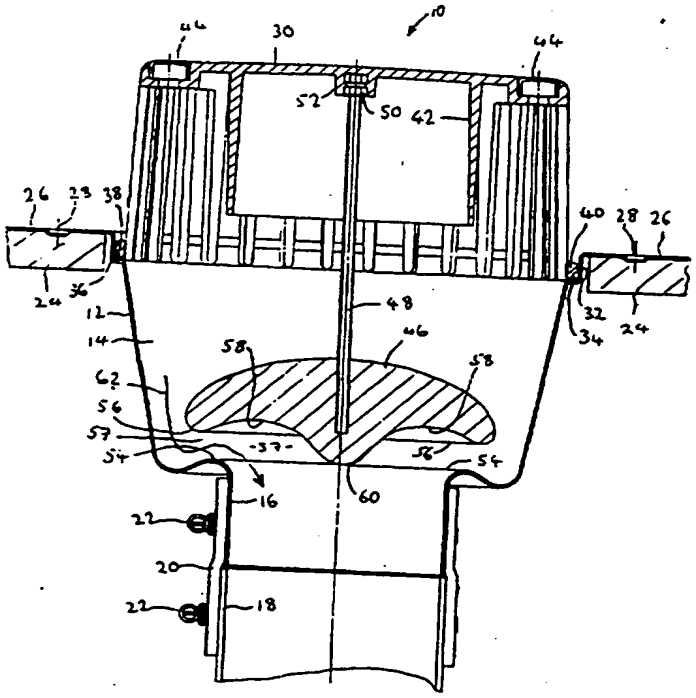

Fig. 1

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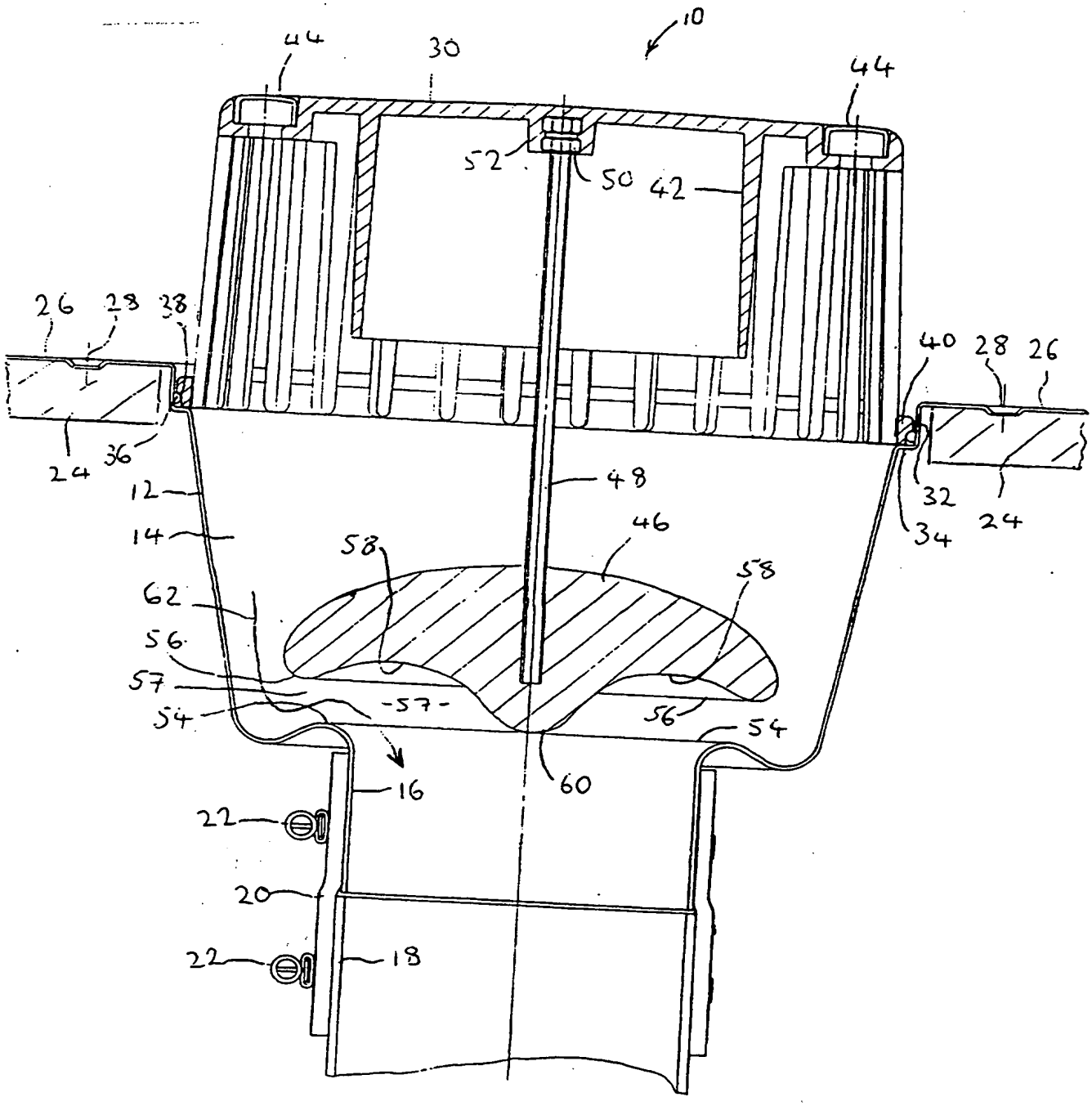
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Fig. 1

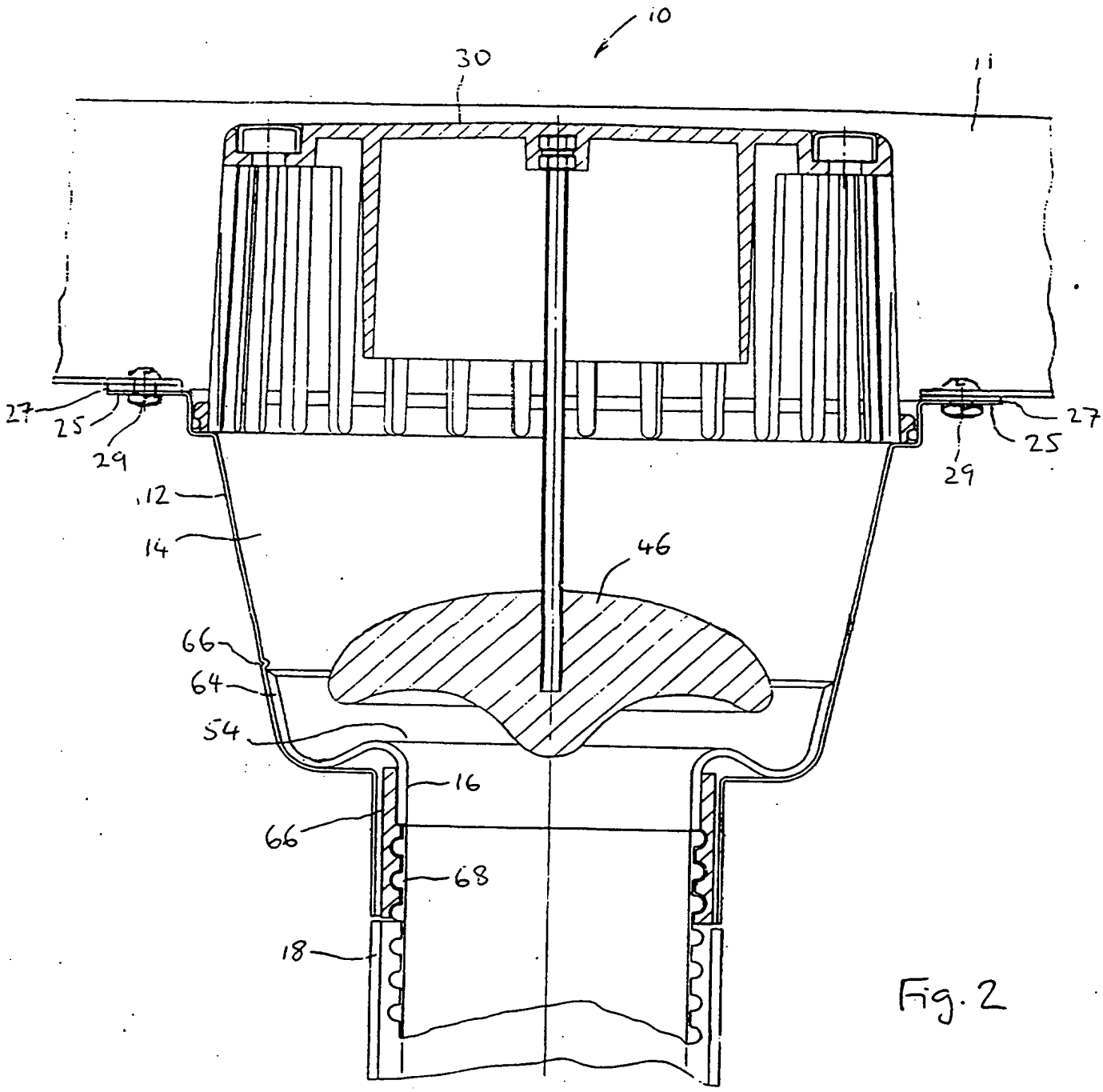

Fig. 2

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Head-Induced Syphonic Rainwater Outlet

This invention relates to outlets for draining rainwater from surfaces such as flat roofs or paved areas, or from gutters, such outlets either being stand alone products or for use with an associated pipework or gutter system.

Our UK patent specification no. GB 2285460 discloses an outlet comprising an upwardly open sump for receiving water from a gutter or a surface to be drained and accumulating a head of water; an inlet passage extending upwardly from towards the bottom of the sump for discharging the accumulated water and a syphonic outlet passage extending downwardly from the upper end of the inlet passage. In a preferred form the inlet passage concentrically surrounds the outlet passage. The sump and arrangement of passages is effective in inducing syphonic flow in the outlet passage when only a small head of water exists in the gutter or on the surface to be drained.

The disclosed outlet design is however hydraulically inefficient. Consequently, flow rates through the outlet are low until syphonic flow is established, whereupon there is a sharp transition to much higher flow rates. The outlet will therefore perform effectively in draining a given area using a pipework system of smaller capacity than is possible with non-syphonic outlet designs. However if the pipework is not designed at the outset to withstand syphonic operation, the sharp transition to syphonic flow at only moderate levels of rainfall can cause problems, in extreme cases even failure of pipes, their mountings and joints. The sharp transition in flow regimes may result in surging of flow during light rainfall conditions whereas sustained heavier rainfall intensity will induce a constant syphonic condition.

The present invention aims to mitigate these problems and accordingly provides a rainwater outlet comprising a sump for reception of water to be drained and a passage extending upwardly from an inlet orifice at a lower region of the sump, over a crest and downwardly to a discharge end, wherein the uppermost point of the inlet orifice in use lies substantially at or above the level of the crest. Such an outlet is capable of inducing syphonic flow at high flow rates. However the increase in flow through the

outlet and transition to syphonic flow is gradual as the depth of water in the sump increases. Compared equal pipe size for pipe size and with equal surface rainwater depths and equal outlet diameters, the drainage capacity of the new outlet exceeds that of a traditional gravity outlet. Using an outlet of the present invention, the pipework can operate up to about 90% full of water, by which point syphonic flow will have been induced within the outlet.

Preferably the inlet orifice concentrically surrounds the discharge end. The discharge end may comprise a spigot extending downwardly from a floor of the sump, with the remainder of the passage being formed between the floor and a cap supported above the floor. The crest may comprise the uppermost point of a ridge surrounding the upper end of the spigot. The undersurface of the cap may comprise a depending lip forming an upper boundary of the orifice. The sump may have walls joined to the floor by a smoothly radiussed transition region and the cap lip, ridge and undersurface may likewise be smoothly radiussed, whereby the passage has a cross-sectional profile of lazy s shape.

In a further aspect, the invention provides a drainage system comprising pipework and an outlet capable of inducing syphonic flow, the outlet having a tail pipe connected to the pipework via a syphon break, whereby the pipework is not subjected to syphonic flow. This will ensure that the pipework does not experience the higher stresses associated with syphonic flow, whilst at the same time most if not all of the benefits of the high performance syphonic outlet are retained. The syphonic outlet and syphon break could, for example, replace a conventional non-syphonic outlet. The overall performance of the system will be improved without any danger of over stressing the existing pipework designed for non-syphonic operation.

A convenient way of forming the syphon break is for the tail piece to be non-sealingly telescopingly received in an upper end of the pipework. Alternatively, an air inlet can be used, or a chamber or portion of the pipework having an increased flow cross section can be provided to act as the syphon break.

In a corresponding aspect, the invention comprises a method of connecting a rainwater outlet capable of syphonic operation to a pipework

system, comprising the step of forming a syphon break between the outlet and the pipework system.

Illustrative embodiments of the invention are described below with reference to the drawings wherein:-

Fig. 1 is a cross-sectional view of a first outlet embodying the invention and Fig. 2 is a cross-sectional view of a second outlet embodying the invention.

The rainwater outlet 10 shown in figure 1 comprises a body 12 of spun aluminium or stainless steel defining a sump 14 in which a head of water may accumulate. A spigot 16 leads water away from the sump into pipework 18 to which the spigot is connected by a standard flexible pipe sealing joint 20 and worm drive clips 22. The body 12 is secured in a hole in a roof deck 24 by an upper flange 26 provided with screw holes 28. A bituminous membrane covering the deck 24 is secured and sealed to the flange 28 by a clamping ring (not shown). The flange 28 also has a PVC coating to which PVC single ply membranes can be welded or adhered.

A domical grating 30 serving as a leaf and stone guard is secured as a push fit in a widened mouth 32 of the sump14 which joins the flange 26 and body 12 to form a supporting shoulder 34. The grating 30 is frictionally retained by an O ring 36 mounted in a recess 38 cast into the rim 40 of the grating 30. The grating 30 is a standard component including a depending vortex suppression skirt 42 as described in our patent application no. GB9623909. As shown the skirt 42 is supported sufficiently far above the body 12 so that flow through the outlet 10 becomes syphonic before the skirt depends into the water stream. The skirt 42 therefore has very little if any influence on flow performance of the outlet 10. However if desired the skirt can be supported at a lower level so that it depends into the water stream acting to reduce air entrainment and to establish syphonic flow at lower flow rates than in its absence. Bolt holes normally used to secure the standard grating 30 to a cast metal body are blanked off by plastics inserts 44.

A cap 46 is suspended concentrically above the spigot 16 on a stud 48 screwed at its upper end into a threaded inset 50 cast into a boss 52 formed at the centre of the grating 30. The floor of the sump is dished inwardly to form a smoothly radiussed crest 54 surrounding the spigot 16. The transition region between the sump side walls and floor is also smoothly radiussed.

A smoothly radiussed lip 56 of the cap 46 forms the uppermost point of an inlet orifice 57 from which a discharge passage leads upwardly over the crest 54 to a discharge end formed by the spigot 16. The underside of the cap 46 is vaulted at 58 and has a central downward protruberance 60. The discharge passage thereby defined between the cap underside and the crest 54 has a lazy s profile as indicated by arrow 62. The lip 56 lies a small distance above the crest 54.

Comparing figures 1 and 2 optionally the flange 26 may be replaced by a smaller diameter flange 25 by which the outlet 10 can be fixed beneath a discharge hole formed in a flat bottomed gutter 11. The flange 25 is secured and sealed to the hole periphery by bolts 29 and a gasket 27.

The body 12 of the outlet 10 shown in figure 2 has a flat bottom and the crest 54 is formed in a UPVC insert 64 retained as a snap fit in the bottom of the sump 14 by three dimples 66 pressed in the body side walls (only one dimple 66 shown). The insert 64 is bonded to a threaded plastics socket 66 for retaining a tailpiece 68 formed from flexible plastics hose which extends into the adjacent pipework 18. The flexibility of the hose 68 allows connection to curved pipes.

If desired, the insert 64 and socket 66 can be sealed to the body 12 by mastic, adhesive or potting compound. The joint between the spigot 16 and the pipe 18 can then remain unsealed and acts as a syphon break by allowing entry of air. However, usually the spigot 16 and pipe 18 will be joined by a sealed connection such as 20 shown in figure 1. It is then unnecessary to seal the insert 64 and socket 66 in the body 12. The increase in flow passage diameter at the downstream end of the hose 68 where it enters the pipe 18 will also act as a syphon break. Optionally the sealed connection 20 or pipework to which the inlet 10 is connected can incorporate an air inlet, for example a one-way valve.

CLAIMS

1. A rainwater outlet comprising a sump for reception of water to be drained and a passage extending upwardly from an inlet orifice at a lower region of the sump, over a crest and downwardly to a discharge end, wherein the uppermost point of the inlet orifice in use lies substantially at or above the level of the crest.

2. An outlet as claimed in claim 1 wherein the inlet orifice concentrically surrounds the discharge end.

3. An outlet as claimed in claim 2 wherein the discharge end comprises a spigot extending downwardly from a floor of the sump.

4. An outlet as claimed in claim 3 wherein the remainder of the passage is formed between the floor and a cap supported above the floor.

5. An outlet as claimed in claim 4 wherein the crest comprises the uppermost point of a ridge surrounding the upper end of the spigot.

6. An outlet as claimed in claim 4 or 5 wherein the undersurface of the cap comprises a depending lip forming an upper boundary of the orifice.

7. An outlet as claimed in any preceding claim wherein the sump has walls joined to the floor by a smoothly radiussed transition region.

8. An outlet as claimed in claims 6 and 7 wherein the cap lip, ridge and undersurface are smoothly radiussed, whereby the passage has a cross-sectional profile of lazy s shape.

9. A drainage system comprising pipework and an outlet capable of inducing syphonic flow, the outlet having a tail pipe connected to the pipework via a syphon break, whereby the pipework is not subjected to syphonic flow.

10. A system as claimed in claim 9 wherein the tail piece is non-sealingly telescopingly received in an upper end of the pipework.

11. A system as claimed in claim 9 wherein an air inlet is connected to the

pipework.

12. A system as claimed in claim 9 wherein the syphon break comprises a portion of the pipework having an increased diameter or a chamber having a relatively larger flow cross section.

13. A method of connecting a rainwater outlet capable of syphonic operation to a pipework system, comprising the step of forming a syphon break between the outlet and the pipework system.

The Patent Office

Application No:	GB 9700387.5	**Examiner:**	D. Haworth
Claims searched:	1-8	**Date of search:**	19 March 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): E1C (C18)

Int Cl (Ed.6): E04D 13/04

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2285460 A	(Harmer Holdings)	
A	GB 2269402 A	(Fullflow Systems)	
A	WO 94/18414 A	(Harmer Holdings)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.